06-29-00

A

UNITED STATES PATENT APPLICATION TRANSMITTAL FORM

BOX PATENT APPLICATION
ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Docket No.: 971.0037USU

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): Hiroshi Tatekawa, Yukio Nishimura, and Katsumi Sakamoto

For: APPARATUS FOR DEBUGGING IMAGING DEVICES AND METHOD OF TESTING IMAGING DEVICES

Enclosed are:

XXX Specification (24 pps.) consisting of: Description (19 pps); Claims (4 pps); Abstract (1pp);

XXX 5 sheets of drawing;

XXX Declaration and Power of Attorney;

XXX An assignment of the invention to: Agilent Technologies, Inc., including $40.00 recordation fee and Assignment Recordation Form Cover Sheet;

____ Verified Statement (Declaration Claiming Small Entity Status - Small Business Concern;

____ Information Disclosure Statement (with copies of patent);

____ Form - PTO-1449;

XXX Priority of application Serial No. 11-184837 filed on 30 June 1999, in Japan is claimed under 35 U.S.C. §119;

XXX Priority document of Serial No. 11-184837 filed on 30 June 1999, in Japan ;

____ Preliminary Amendment.

The Filing Fee is calculated below.

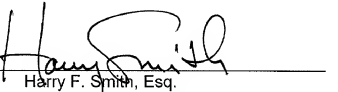
CLAIMS AS FILED				
(1) For	(2) Number Filed	(3) Number Extra	(4) Rate	(5) Basic Fee $690.00
Total Claims	8 - 20 =	0	x $18.00	$0
Independent Claims	4 - 3 =	1	X $78.00	$78.00
Multiple Dependent Claim Fee			x $260.00 =	$0.00
TOTAL FILING FEE				**$768.00**
1/2 FILING FEE FOR SMALL ENTITY				$

XXX A check in the amount of $ **808.00** to cover the filing fee ($768) and the Assignment recorded fee ($40) is enclosed.

XXX The Commissioner is hereby authorized to charge any additional fees under 37 C.F.R. §§1.16 and 1.17 which may be required with this communication or during the entire pendency of the application, or credit any overpayment, to **Deposit Account No. 01-0467.** A duplicate copy of this Form is enclosed.

Address all future communications to: **Harry F. Smith, Esq.**
Ohlandt , Greeley, Ruggiero & Perle, L.L.P.
One Landmark Square, 9th Floor
Stamford,Connecticut 06901-2682
U.S.A.

June 28, 2000
Date of Signature



Harry F. Smith, Esq.
Attorney for Applicant(s)
Ohlandt, Greeley, Ruggiero & Perle, L.L.P.
Registration No. 32,493
(203) 327-4500

CERTIFICATE OF EXPRESS MAILING

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" Certificate No. **EL640201130US,** service under 37 CFR §1.10 and is addressed to: Box Patent Application, Assistant Commissioner for Patents, Washington, D.C. 20231 on June 28, 2000.

Nicholas Grimaldi, Jr.
(Typed name of person mailing paper)

(Signature of person mailing paper)

PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

1. Date of Application: June 30, 1999

2. Application Number: Heisei 11th year patent application no. 11-184837

3. Applicant(s): AGILENT TECHNOLOGIES JAPAN, LTD

March 31, 2000

Commissioner, Patent Office — Takahiko Kondo (seal)

Shusshobango Shusshoutoku 2000-3021467

[Name of Document] Application for Patent
[Docket Number] 40990007
[Filing date] June 30, 1999
[Addressee] Patent Office Commissioner
[IPC] G06T 5/00
[Title of the invention] APPARATUS FOR DEBUGGING IMAGING DEVICES AND METHOD OF TESTING IMAGING DEVICES
[Number of Claims] 8
[Inventor]
[Address] 9-1 Takakura-cho, Hachioji-shi, Tokyo c/o HEWLETT-PACKARD JAPAN, LTD.
[Name] Hiroshi Tatekawa
[Inventor]
[Address] 9-1 Takakura-cho, Hachioji-shi, Tokyo c/o HEWLETT-PACKARD JAPAN, LTD.
[Name] Yukio Nishimura
[Inventor]
[Address] 9-1 Takakura-cho, Hachioji-shi, Tokyo c/o HEWLETT-PACKARD JAPAN, LTD.
[Name] Katsumi Sakamoto
[Applicant]
[Identification Number] 000121914
[Address or Domicile] 9-1 Takakura-cho, Hachioji-shi, Tokyo
[Name] HEWLETT-PACKARD JAPAN, LTD.
[Representative] Masao Terazawa
[Agent]
[Identification Number] 100078053
[Patent Attorney]
[Name] Hideo Kamino
[Official Fees]
[Deposit Account No.] 042745
[Official Fees] 21,000
[List of Attached Documents]

[List of Attached Documents]

[Name of Document]	Specification	1
[Name of Document]	Drawings	1
[Name of Document]	Abstract	1
[General power of attorney number]	9406831	
[Request for Proof]	Yes	

Applicant History Information

Identification number [000121914]

1. Date of Amendment June 2, 1995
[reason for amendment] change of the name

Address 9-1 Takakura-cho, Hachioji-shi, Tokyo
Name HEWLETT-PACKARD JAPAN, LTD.

2. Date of Amendment November 1, 1999
[reason for amendment] change of the name

Address 9-1 Takakura-cho, Hachioji-shi, Tokyo
Name AGILENT TECHNOLOGIES JAPAN, LTD.

TITLE OF THE INVENTION

APPARATUS FOR DEBUGGING IMAGING DEVICES AND METHOD OF TESTING IMAGING DEVICES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a debugging apparatus referred to as a viewer for analyzing and displaying measured data in a semiconductor test and a method of displaying test results.

2. Description of the Related Art

The resolution of imaging devices such as CCD chips is greatly increasing at present. The growing resolution of imaging devices requires imaging device tests to handle and process a very large amount of information.

Generally, when developing and testing image capturing devices or imaging devices such as CCDs, CMOS imagers, etc., it has been customary to capture an image of a test pattern with a device under test, output the captured image from the device, and inspect image data of the captured image processed for color filtering, smoothing, etc. to determine whether the device under the test is acceptable or not. To determine the acceptability of the tested device, the numerical values of the processed image data are inspected for all the pixels. In the inspection, it has been the general practice to employ an apparatus dedicated for testing

imaging devices and automatically select those imaging devices whose values fall in a certain range according to a test program.

Recently, however, more and more imaging devices are tested using general-purpose semiconductor testing apparatus (so-called IC testers). When such a general-purpose IC tester is used to test an imaging device, no test pattern is employed, but the imaging device is placed on a test head connected to the IC tester, and irradiated with light to conduct the test. The operator operates a personal computer connected to the IC tester to analyze and display test results.

One conventional image inspection process is disclosed in Japanese laid-open patent publication No. 7-230546, for example. According to the disclosed image inspection process, an inspected image is displayed as a histogram and analyzed.

During a development stage for imaging devices, a test program often incorporates steps of displaying or printing processed results as binary, octal, or hexadecimal numerical values for the operator to confirm the processed results. Occasionally, the displayed and printed data may cover the values of all pixels of an imaging device being tested. In recent years, imaging devices with several million pixels have been developed and manufactured as such digital cameras

are finding widespread use among consumers.

According to a conventional process of displaying test information, the characteristic value of each pixel is usually represented by an analog gradation, and those characteristic values of plural pixels are simultaneously displayed to generate an image of captured data on a display unit. Specific numerical values for pixels can be displayed by moving a cursor or the like, and can be retrieved when necessary. When such pixel information is displayed as areas with varying brightness and darkness (luminance information) on the display unit, the operator can recognize the general tendency of the pixel information. However, the operator finds it difficult to determine and compare specific values, such as specific numerical values for certain pixels and differences between specific numerical values for adjacent pixels, e.g., upper, lower, left, and right pixels, from only the displayed pixel information.

Even though the test program incorporates the steps of displaying or printing all numerical data of pixels of an imaging device for confirmation, it is tedious and time-consuming for the operator to confirm a certain area of pixels because the numerical data are too many if the number of the pixels in the imaging device is very large. If a range to be displayed is specified in the displaying step, then when such a range is changed, the displaying step

incorporated in the test program has to be changed. For displaying numerical values, they should not only be dumped and displayed successively in the order of addresses, but also be dumped while relative positions of the addresses are being calculated taking the arrangement of the pixels in the imaging device into consideration, so that, for example, the numerical values of horizontally adjacent pixels can be compared with each other and also the numerical values of vertically and obliquely adjacent pixels can be compared with each other. If the number of vertically and horizontally arrayed pixels is very large, then special care must be taken to dump and display the numerical values of the pixels. A large expenditure of labor and time may be required to incorporate, in each test program, the displaying step taking into account the proper relationship between an area that needs to be displayed and the addresses of original data.

For observing the tendency among codes representing the characteristics of each dot in an imaging device under test, the codes may be displayed as characters or symbols directly over a map which is displayed on a display screen as representing the imaging device. However, since the codes displayed as characters or symbols take up relatively large areas on the display screen, the range that can be displayed by the codes at once is more limited than the range that can be displayed using dots, and hence all the data cannot be

displayed together on the display screen.

Also a display unit is known for displaying a dot image of visual luminance information converted from original data or processed data.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to easily display a code view in a necessary area of an imaging device under test for the operator to be able to read the detailed and specific tendencies of characteristic changes among pixels in the necessary area of the imaging device.

Another object of the present invention is to relate an area to be displayed in the code view to an area to be displayed in an image view, so that all necessary data can be displayed using codes in the code view while at the same time they can also be displayed as an image in the image view.

According to an aspect of the present invention, there is provided an apparatus for debugging an imaging device, comprising an image view display or image view displaying means for qualitatively displaying pixel characteristics in a first range of the imaging device, and a code view display or code view displaying means for quantitatively displaying numerical or symbolic data of individual pixels in a second range that is smaller than the first range and designated within an area displayed by the image view display.

According to another aspect of the present invention,

there is also provided a semiconductor testing apparatus for testing an imaging device, comprising a test head for reading an output signal from an imaging device under test; an IC tester which receives and processes output data from the test head; a memory for storing output data from the IC tester; a display unit for displaying data stored in the memory; an input device for receiving an operator's command; a central processing unit for processing data stored in the memory based on an operator's command received from the input device, which central processing unit connected to the display unit and the input device and the IC tester; an image view display for qualitatively displaying pixel characteristics in a first range of the imaging device on the display unit according to an operator's command; and a code view display for quantitatively displaying numerical or symbolic data of individual pixels in a second range that is smaller than the first range and designated within an area displayed by the image view display on the display unit, whereby data with respect to the pixel characteristics of the imaging device can be displayed by means of the image view display or the code view display or both.

According to still another aspect of the present invention, there is further provided a method of testing an imaging device, comprising the steps of retrieving output data from the imaging device as digital data, qualitatively

displaying the digital data as an image view in a first range of the imaging device, receiving the designation of a second range that is smaller than the first range in the qualitative image view, and quantitatively displaying characteristics of pixels within the second range in the imaging device with numerical or symbolic codes.

The present invention also provides a computer-readable recording medium storing a program for carrying out the above method. Specifically, there is provided a computer-readable recording medium storing a program for enabling a computer to function as an image view display for qualitatively displaying pixel characteristics in a first range of an imaging device, and a code view display for quantitatively displaying numerical or symbolic data of individual pixels in a second range that is smaller than the first range and designated within an area displayed by the image view display.

According to the present invention, an operator can easily display pixel data in both the image view and the code view and also switch between the image view and the code view. While analyzing pixel data, the operator can make detailed judgements on pixel data for a certain area simply by designating that area for observation. Therefore, the operator finds it easy to debug the imaging device which has a relatively large number of pixels.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of an overall arrangement of a test system including viewers according to the present invention;

FIG. 2 is a block diagram of a software architecture required to test an imaging device with an IC tester according to the present invention;

FIG. 3 is a flowchart of an operation sequence of a debugger for an imaging device;

FIG. 4 is a view showing an example of an image view and a code view which are displayed according to the present invention; and

FIG. 5 is a view showing another example of an image view and a code view which are displayed according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description, the display of data relative to a pixel as an image will be referred to as an "image view", and the display of numerical values representative of the characteristics of pixels as binary, octal, decimal, hexadecimal, or other numerical values or symbols will be referred to as a "code view". When an area is designated in the image view, the code view can be generated for the designated area. Therefore, the code view can be generated easily from the image view.

The image view refers to a display process in which each or a few pixels of an imaging device are associated with respective pixels in a display unit, and the characteristic values of pixels of the imaging device are displayed as color changes or monochromatic shades on the display unit. Specifically, the characteristic values of pixels in the imaging device are numerically processed for increasing contrast, low-pass filtering, finding variations from their average, and singularity processing, and the processed characteristic values are presented in an easily recognizable fashion to the operator. Therefore, image views are suitable for the operator to view qualitative changes of the characteristics of the pixels in the overall imaging surface of the imaging device or in a wide range in the imaging surface of the imaging device. For example, image views are suitable for the operator to recognize a defective group of pixels or shading, i.e., gradual characteristic fluctuations, among widely spaced pixels, e.g., among upper and lower ends of the imaging surface of the imaging device. However, while the operator can understand a general tendency of the imaging device from the image view, the operator finds it difficult to clearly recognize how the characteristics of a certain pixel change from the characteristics of an adjacent pixel. Furthermore, using the image view, it is not possible for the operator to find out whether a defect appearing as a dot is

related to a single pixel or a plurality of pixels. The code view is a display process which allows the operator to view quantitative data of the characteristic values of pixels. It should, however, be noted that the code view does not necessarily display data from an IC tester as they are. Rather, depending on the nature of test items or the type of information required by the operator, the numerical values of pixels for code views may be limited in the number of digits to be displayed, converted into symbols, displayed as binary, octal, decimal, hexadecimal, or other numerical values, or filtered.

FIG. 1 shows in a block form an overall arrangement of a test system having the viewer according to the present invention. As shown in FIG. 1, an imaging device 101, which is a device under test (DUT), is electrically connected to a DUT board 103 placed in a test head 102. Light is applied from a light source 104 to the imaging device 101 to cause the imaging device 101 to output electric signals under the control of an IC tester 105. The operator controls the IC tester 105 from a user interface control processor (UIP) 107 via a LAN such as the Ethernet or a bus. Digital data output from the DUT board 103 is delivered via an interface board (not shown) in the test head 102 to an interface 106 in the IC tester 105. The timing of the digital data is adjusted by a timing control unit (not shown) in the IC tester 105, and

then sent to an image processor 108. The image processor 108 includes a keyboard 109 and a mouse 110 that are operated by the operator, and a display unit 111. The image processor 108 can process and display received digital data. The image processor 108 comprises a personal computer or a computer such as a work station, for example. The image processor 108 is connected to the IC tester 105 and the UIP 107 by a LAN such as the Ethernet or a bus for exchanging test information and processed data therewith.

FIG. 2 shows in block form a software architecture required to test an imaging device with the IC tester 105. A test program for generally managing and conducting a test in its entirety is run by the IC tester 105. The test program controls an imaging device under test to output data which is read into the image processor 108 by an image processing program run by the image processor 108. The image processor 108 has a debugger 120, a sub-module process 121, a data memory 122, an image display viewer 123, and a code display viewer 124. The debugger 120, the image display viewer 123, and the code display viewer 124 are directly operated by an operator 125. The data memory 122 has a storage capacity large enough to store a plurality of sets of data for all the pixels in the imaging device under test. One-dimensional data obtained in one measurement cycle by sweeping all the pixels is stored in the data memory 122, and analyzed with

respect to necessary test items. Analyzed data is stored in the data memory 122, so that old and new analyzed data can be compared with each other.

FIG. 3 shows an operation sequence of the debugger 120, which is executed by the image processor 108. A process of debugging test results for an imaging device with the debugger 120 will be described below with reference to FIG. 3. First, the debugger 120 is activated in step 401, and executes an image-processing program on the image processor 108 in step 402. Output data produced from the imaging device under test according to the image processing program is retrieved into the data memory 122 in step 403. The debugger 120 specifies which block of the data in the data memory 122 is to be displayed in step 404, and then presents an image display in step 405. The debugger 120 determines, from the image display, whether there is a range to be presented in the code display or not in step 406. If there is a range to be presented for a code display, then the debugger 120 presents a code display in the range in step 407. Thereafter, the debugger 120 determines whether there is another block for code display or not in step 408. If there is another block for code display, then control returns to step 404 in which the debugger 120 specifies the block of the data in the data memory 122 is to be presented. If there is no range to be shown in the code display in step 406, then

control jumps to step 408 in which the debugger 120 determines whether there is another block for code display or not. If there is no other block for code display in step 408, then the debugger 120 determines whether the data is to be further analyzed or not in step 409. If the data is to be further analyzed, then control returns to step 402. If the data is not to be further analyzed, then the operation sequence of the debugger 120 is ended. In this manner, the operator can debug the imaging device under test to see if each of the pixels of the imaging device has a problem or not, or if the controlling of the imaging device according to the test program run by the IC tester 105 is problematic or not, while switching between image and code displays on the display unit 111.

FIG. 4 shows an example of presented display views produced by the viewer of the present invention. As shown in FIG. 4, output data from the imaging device under test is displayed as an image display view 200 on the display screen of the display unit 111. The image display view 200 may comprise monochromatic or colored gradations. In the illustrated example, pattern data from the imaging device under test, which has a large number of pixels, is to be displayed. Because the pattern data to be displayed is very large, only a certain range of all the pixels of the imaging device is displayed in the image display view 200. The image

display view 200 includes a scroll bar 201. When the operator operates the scroll bar 201, the displayed pixel range can freely be moved in the image display view 200. In this example, the operator designates an initial cursor (or pointer) position 202 in the image display view 200 as a starting point for a rectangular area, and then designates an ending point 203 for the rectangular range by dragging the mouse or operating a key on the keyboard 109, for example. Thereafter, the operator operates the mouse or the keyboard to give a command to display a code display view 210. When the operator specifies the cursor positions 202, 203, a frame 204 of the rectangular area may be displayed to allow the operator to visually recognize the selected rectangular area. The image display view 200 also shows a black dot 206 as a defect in the rectangular area and other defects 207 of the imaging device under test.

The image display view 200 shows, in a lower right corner thereof, coordinates of the center of the rectangular area and a selected size of the rectangular area shown as the code display view 210. The code display view 210 shows codes including numerical values and symbols. The image display view 200 and the code display view 210 may be presented in various patterns, e.g., in an overlapping manner or separately as individual windows, or may be selectively displayed one at a time. The code display view 210 may be

presented in a size that is automatically variable depending on the number of pixels shown, or may be shown in a fixed size at all times. At any rate, once the image display view 200 and the code display view 210 are shown, their sizes and positions should preferably be made variable by the cursor, which can be moved by the mouse or the keyboard. The test program developer or the operator can thus confirm easily certain pixels and their numerical values while the pixels are being held in a mutual positional relationship. The image display view 200 and the code display view 210 enables the test program developer or the operator to verify whether the output data from the imaging device under test are properly processed, confirm what numerical value a certain white dot on the imaging device under test has as a code, and obtain materials for debugging decisions as to whether the imaging device is operating properly or the test program contains an error, through comparison between the numerical values of adjacent pixels.

The debugging apparatus according to the present invention is capable of efficiently debugging imaging devices under stricter inspection standards. The debugging apparatus also allows the operator to grasp macroscopic characteristic changes in entire displayed images, such as slow pixel characteristic fluctuations, of imaging devices having a large number of pixels, and also to reliably recognize

changes that may often be overlooked when many pixels are shown in one image on the imaging devices, such as small changes found through comparison between the characteristic values of adjacent pixels or a defect of a single pixel or a plurality of pixels.

The cursor shown in the image display view 200 may be in the form of a criss-cross shape or an arrow shape. While a rectangular area can be specified in its entirety to be displayed as a code display view as described above with reference to FIG. 4, the code display view may be presented for a rectangular area having a predetermined size surrounding a central point that has been specified by the operator.

When the cursor in the image display view 200 is moved through the use of the mouse or the keyboard, the codes related to the pixels in the code display view 210 are accordingly updated on a real-time basis. Alternatively, the codes in the code display view 210 may not be updated until the cursor is moved to a point and the point is determined by clicking the mouse.

Furthermore, the window of the code display view 210 may be focused or made active and entry modes may be changed, and then X, Y coordinates of the cursor may be entered as numerals directly into entry display frames 211, 212 in an upper portion of the code display view 210, or the cursor in

the image display view 200 may be operated by the keyboard to move a central pixel in the image display view 200, so that the range of pixels presented in the image display view 200 and the code display view 210 can be moved. A marker representing pixel data at the central position in the code display view area may be shown in the code display view 210. For example, such a marker may comprise a numerical value or a background shown in a special color.

FIG. 5 shows another example of an image display view and a code display view which are shown according to the present invention. In the example shown in FIG. 5, both image and code views are shown, and as the cursor moves in the image display view, codes corresponding to pixels in an area to be shown in the code display view are newly calculated, and the code display view is updated into new codes. Specifically, as shown in FIG. 5, a displayed image 300 includes an image display view 301 and a code display view 302, with a cursor displayed in the image display view 301. When the cursor is moved in the image display view 301, codes displayed in the code display view 302 are updated.

Codes are displayed in the code display view 302 immediately after effective data are displayed in the image display view 301. Alternatively, codes may be displayed in the code display view 302 or displayed codes may be updated in the code display view 302 when the mouse or the keyboard

is operated in a certain way after effective data are displayed in the image display view 301 and the cursor is moved.

When the center of the cursor is located at an upper, lower, left-hand, or right-hand end of the image display view 301, e.g., at a left-hand end of the image display view 301 as shown in FIG. 5, and a rectangular area for the code display view 302, e.g., a rectangular area having a starting point 220 and an ending point 221 as indicated by the dotted line in FIG. 5, has a portion projecting out of the image display view 301, the code display view 302 may display non-code data with special characters, e.g., hyphens "---" in its region corresponding to the projecting portion of the rectangular area. The code display view 302 may also display such non-code data with characters other than hyphens, blanks, other symbols, or colors. The image processor 108 is implemented such that when the cursor (pointer) in the image display view 301 moves toward an upper, lower, left-hand, or right-hand end of the range to be tested of the imaging device and the range of codes to be shown in the code display view 302 is about to move beyond the end of the range to be tested of the imaging device, the cursor (pointer) is stopped against movement beyond the end of the range. However, the image processor 108 may alternatively be implemented such that when the range of codes to be shown in the code display

view 302 is about to move beyond the end of the range to be tested of the imaging device, the cursor (pointer) may not be limited in its movement, but non-code data may be shown in the code display view 302 in response to the movement of the cursor (pointer).

The entire disclosure of Japanese Patent Application No. 184837/1999 filed on June 30, 1999 including specification, claims, drawings, and summary are incorporated herein by reference in its entirety.

CLAIMS

1. An apparatus for debugging an imaging device, comprising:

an image view display for qualitatively displaying pixel characteristics in a first range of the imaging device; and

a code view display for quantitatively displaying numerical or symbolic data of individual pixels in a second range that is smaller than said first range and designated within an area displayed by said image view display.

2. A semiconductor testing apparatus for testing an imaging device, comprising:

a test head for reading an output signal from an imaging device under test;

a memory which stores output data from said test head; and

an image processor which processes the output data stored in said memory;

wherein said image processor comprising:

a display unit for displaying data stored in said memory;

an input device which receives an operator's command;

wherein said image processor processes data stored

in said memory means based on an operator's command received from said input device;

wherein said image processor comprises an image view display for qualitatively displaying pixel characteristics in a first range of the imaging device on said display unit according to an operator's command, and a code view display for quantitatively displaying on said display unit numerical or symbolic data of individual pixels in a second range that is smaller than said first range and designated in an area displayed by said image view display;

whereby data with respect to the pixel characteristics of the imaging device can be displayed by said image view display or said code view display or both.

3. A semiconductor testing apparatus according to claim 2, wherein said image view display comprises an image view, and an area display that indicates on the image view a code display area of the code view.

4. A semiconductor testing apparatus according to claim 2, wherein said code view display comprises a code view and a coordinate display for displaying the coordinates of data located at a central position in said code view display.

5. A semiconductor testing apparatus according to claim

2, wherein said code view displaying means comprises a code view and a marker display for indicating data shown at a central position in said code view display.

6. A method of testing an imaging device, comprising the steps of:

retrieving output data from the imaging device as digital data;

qualitatively displaying the digital data as an image view in a first range of the imaging device;

accepting the designation of a second range that is smaller than said first range in the image view, which qualitatively displays digital data; and

quantitatively displaying characteristics of pixels in the imaging device within said second range with numerical or symbolic codes.

7. A method according to claim 6, wherein the step of retrieving output data from the imaging device comprises the step of processing the retrieved digital data.

8. A computer-readable recording medium storing a program for enabling a computer to function as:

an image view display for qualitatively displaying pixel characteristics in a first range of an imaging device; and

a code view display for quantitatively displaying numerical or symbolic data of individual pixels in a second range that is smaller than said first range and designated within an area displayed by said image view display.

ABSTRACT OF THE DISCLOSURE

To facilitate the debugging an imaging device having a large number of pixels, a debugging apparatus has an image view display for qualitatively displaying pixel characteristics in a first range of the imaging device, and a code view displaying unit for quantitatively displaying numerical or symbolic data of individual pixels in a second range that is smaller than the first range and designated in an area displayed by the image view display.

FIG.1

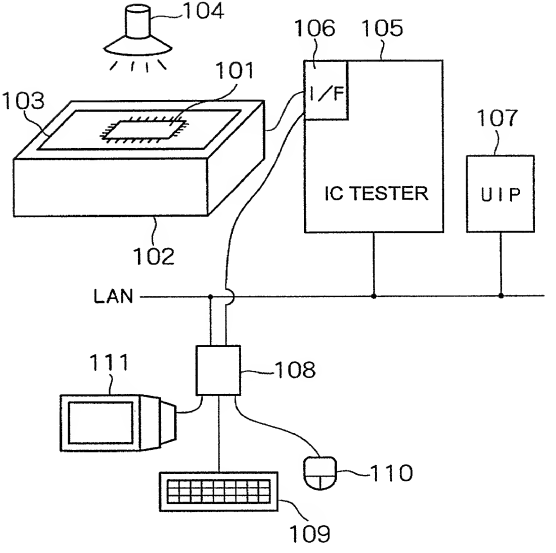


FIG.2

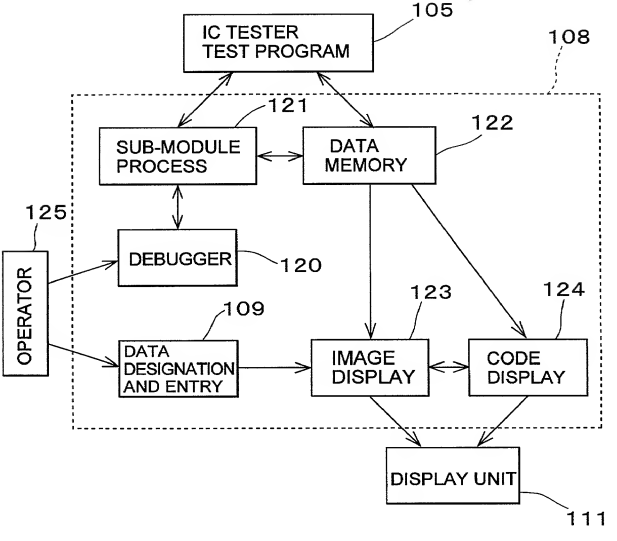

IC TESTER
TEST PROGRAM
105
108
121
SUB-MODULE
PROCESS
DATA
MEMORY
122
125
DEBUGGER
120
OPERATOR
109
123
124
DATA
DESIGNATION
AND ENTRY
IMAGE
DISPLAY
CODE
DISPLAY
DISPLAY UNIT
111

FIG.3

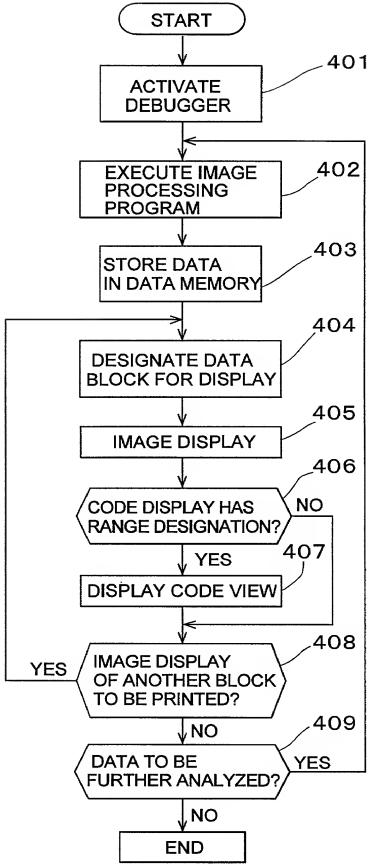

START
ACTIVATE DEBUGGER
401
EXECUTE IMAGE PROCESSING PROGRAM
402
STORE DATA IN DATA MEMORY
403
DESIGNATE DATA BLOCK FOR DISPLAY
404
IMAGE DISPLAY
405
CODE DISPLAY HAS RANGE DESIGNATION?
406
NO
YES
DISPLAY CODE VIEW
407
IMAGE DISPLAY OF ANOTHER BLOCK TO BE PRINTED?
408
YES
NO
DATA TO BE FURTHER ANALYZED?
409
YES
NO
END

FIG.4

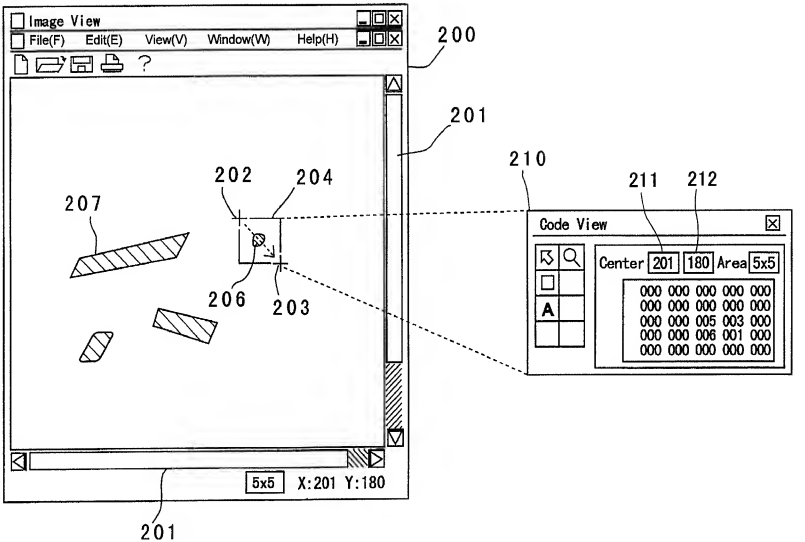


FIG.5

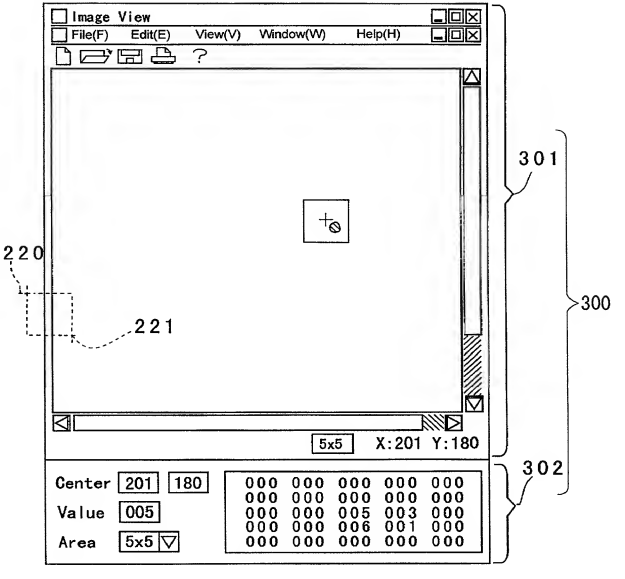


Image View
File(F)
Edit(E)
View(V)
Window(W)
Help(H)
?
220
221
301
300
5x5
X:201 Y:180
302
Center
201
180
Value
005
Area
5x5
000 000 000 000 000
000 000 000 000 000
000 000 005 003 000
000 000 006 001 000
000 000 000 000 000

Declaration and Power of Attorney For Patent Application

特許出願宣言書

Japanese Language Declaration

私は、下欄に氏名を記載した発明者として、以下のとおり宣言する：

As a below named inventor, I hereby declare that

私の住所、郵便の宛先および国籍は、下欄に氏名に続いて記載したとおりであり、

My residence, post office address and citizenship are as stated below next to my name,

名称の発明に関し、請求の範囲に記載した特許を求める主題の本来の、最初にして唯一の発明者である（一人の氏名のみが下欄に記載されている場合）か、もしくは本来の、最初にして共同の発明者である（複数の氏名が下欄に記載されている場合）と信じ、

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

APPARATUS FOR DEBUGGING IMAGING DEVICES

AND METHOD OF TESTING IMAGING DEVICES

その明細書を
(該当する方に印を付す)

☐ ここに添付する。

☐ _____ 日に出願番号

第 _____ 号として提出し、

_____ 日に補正した。
(該当する場合)

the specification of which

(check one)

☒ is attached hereto.

☐ was filed on _____ as

Application Serial No. _____

and was amended on _____
(if applicable)

私は、前記のとおり補正した請求の範囲を含む前記明細書の内容を検討し、理解したことを陳述する。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37部第１章第56条　　項に従い、本願の審査に所要の情報を開示すべき義務を有することを認める。

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

(2-92)

Patent and Trademark Office-U.S. DEPARTMENT OF COMMERCE

Japanese Language Declaration

私は、合衆国法典第35部第119 条にもとづく下記の外国特許出願または発明者証出願の外国優先権利益を主張し、さらに優先権の主張に係わる基礎出願の出願日前の出願日を有する外国特許出願または発明者証出願を以下に明記する：

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior foreign applications
先の外国出願

(Number) (番 号)	(Country) (国 名)	(Day/Month/Year Filed) (出願の年月日)	Priority claimed 優先権の主張	
11-184837	Japan	30 June 1999	☒ Yes あり	☐ No なし
(Number) (番 号)	(Country) (国 名)	(Day/Month/Year Filed) (出願の年月日)	☐ Yes あり	☐ No なし
(Number) (番 号)	(Country) (国 名)	(Day/Month/Year Filed) (出願の年月日)	☐ Yes あり	☐ No なし

私は、合衆国法典第35部第120 条にもとづく下記の合衆国特許出願の利益を主張し、本願の請求の範囲各項に記載の主題が合衆国法典第35部第112 条第 1 項に規定の態様で先の合衆国出願に開示されていない限度において、先の出願の出願日と本願の国内出願日またはＰＣＴ国際出願日の間に公開された連邦規則法典第37部第 1 章第56条 項に記載の所要の情報を開示すべき義務を有することを認める：

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.) (出願番号)	(Filing Date) (出願日)	(現 況) (特許済み、係属中、放棄済み)	(Status) (patented, pending, abandoned)
(Application Serial No.) (出願番号)	(Filing Date) (出願日)	(現 況) (特許済み、係属中、放棄済み)	(Status) (patented, pending, abandoned)

私は、ここに自己の知識にもとづいて行った陳述がすべて真実であり、自己の有する情報および信ずるところに従って行った陳述が真実であると信じ、さらに故意に虚偽の陳述等を行った場合、合衆国法典第18部第1001条により、罰金もしくは禁錮に処せられるか、またはこれらの刑が併科され、またかかる故意による虚偽の陳述が本願ないし本願に対して付与される特許の有効性を損うことがあることを認識して、以上の陳述を行ったことを宣言する。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration

• 委任状：私は、下記発明者として、以下の代理人をここに選任し、本願の手続を遂行すること並びにこれに関する一切の行為を特許商標庁に対して行うことを委任する。
（代理人氏名および登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (*list name and registration number*)

Harry F. Smith (32,493)
Paul D. Greeley (31,019)
Charles N. J. Ruggiero (28,468)

書類の送付先：

Send Correspondence to:

Harry F. Smith, Esq.
Ohlandt, Greeley, Ruggiero & Perle, L.L.P.
One Landmark Square - 9th Floor
Stamford, CT 06901 USA

直通電話連絡先：（名称および電話番号）

Direct Telephone Calls to: (*name and telephone number*)

Harry F. Smith, Esq.
(203) 327-4500

唯一のまたは第一の発明者の氏名	Full name of sole or first inventor HIROSHI TATEKAWA
同発明者の署名　日付	Inventor's signature　Date Hiroshi Tatekawa　May. 11, 2000
住所	Residence Tokyo, Japan
国籍	Citizenship Japan
郵便の宛先	Post Office Address 2-11-3-702 Bessho-cho Hachioji-shi
	Tokyo, Japan
第２の共同発明者の氏名（該当する場合）	Full name of second joint inventor, if any YUKIO NISHIMURA
同第２発明者の署名　日付	Second inventor's signature　Date Yukio Nishimura　May 10, 2000
住所	Residence Tokyo, Japan
国籍	Citizenship Japan
郵便の宛先	Post Office Address 250-2-202 Higashiteragata Tama-shi
	Tokyo, Japan

（第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)

唯一のまたは第一の発明者の氏名	Full name of third inventor KATSUMI SAKAMOTO
同発明者の署名　日付	Inventor's signature　Date Katsumi Sakamoto May. 9. 2000
住所	Residence Tokyo, Japan
国籍	Citizenship Japan
郵便の宛先	Post Office Address 5-9-402 Takakura-cho Hachioji-shi
	Tokyo, Japan
第2の共同発明者の氏名（該当する場合）	Full name of fourth joint inventor
同第2発明者の署名　日付	Inventor's signature　Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

唯一のまたは第一の発明者の氏名	Full name of fifth inventor
同発明者の署名　日付	Inventor's signature　Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address
第2の共同発明者の氏名（該当する場合）	Full name of sixth inventor
同第2発明者の署名　日付	Inventor's signature　Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

（第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)